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UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, MD 21010-5422

AEHA

WATER QUALITY ENGINEERING CONSULTATION NO. 31-24-0813-88
IMPACT/REMEDIATION OF OPEN-PIT FIELD LATRINES

CAMP EDWARDS
BOURNE, MASSACHUSETTS
23-25 SEPTEMBER 1987

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DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

HSHB-ME-WR

WATER QUALITY ENGINEERING CONSULTATION NO. 31-24-0813-88
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CAMP EDWARDS
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1. AUTHORITY. Letter, ARNG, NGB-ARI-E, 22 August 1986, subject: USAEHA FY 87 Environmental Support to the National Guard Bureau.

2. PURPOSE. To determine the scope of impact and develop alternative approaches (if necessary) for addressing potential ground-water contamination caused by the utilization of open-pit field latrines.

3. GENERAL.

a. Abbreviations. See Appendix A for a listing of abbreviations.

b. Personnel Contacted. See Appendix B for listing of personnel contacted.

4. FINDINGS AND DISCUSSION.

a. Background. In 1985, a consultation was conducted by USAEHA (reference 11) to address the potential impact of field training activities at Camp Edwards upon the underlying sole-source aquifer (reference 5). As Camp Edwards encompasses much of the major recharge zone for this critical potable water source, all waste disposal/sanitary practices were evaluated with respect to their potential for contributing to the contamination of ground water. The geology and soil characteristics (references 14 and 16) indigenous to this region of Cape Cod (e.g., the presence of porous, highly permeable soils and relatively rapid ground-water flows) enhanced the need for such evaluation. Among the findings documented was the presence of open-pit field latrines, which permitted a localized, somewhat "short-circuited" route of percolation of domestic wastewater to the ground water. Although flows would be relatively small throughout the year, nitrogen removal - which generally occurs within the top few inches of soil - may be minimized since all surface vegetation was removed and the pits extended several feet below the surface. [Nitrogen, in the ionic form of nitrate, imparts a potentially toxic effect - methemoglobinemia - in infants and toddlers, and has been assigned a maximum contaminant level of 10 mg/L, as nitrogen, as a primary drinking water standard (reference 3)]. Plumes of nitrate contamination have been observed within the ground water of this region (reference 15). The Environmental Assessment published in 1985 (reference 13) depicted these open-pit latrines as concrete vault latrines from which there would emanate no adverse environmental impact. The primary purpose of the current investigation was to determine the viability of recommended remedial alternatives: retrofit of latrines with appropriate floors to preclude the leaching of wastewaters to ground water, the installation of monitoring wells to ascertain if these structures posed an observable threat to the quality of the protected Cape Cod Aquifer, or the justification of taking no action due to the absence of a real threat.

b. Description. At the time of this consultation, 28 field latrines were scattered throughout the training areas of Camp Edwards. The first 24 were constructed during the Fall and Winter of 1982-83 and were in operation for the 1983 training season. The final four facilities were put into service during April 1986. Historically, utilization has remained rather continuous throughout the designated training periods - e.g., approximately May through August - and nonexistent during the remainder of the year. The concrete-block structures were designed to have an open-pit which extended 4 feet 4 inches below the floor elevation (Figure 1). At the time of this consultation, solids (e.g., fecal matter, paper, and debris) had accumulated within the pits, while the wastewater drained through the underlying soils. An access port was located on each building to allow periodic cleaning of the pits; however, this procedure would prove quite difficult in the complete absence of water. Since all wastewater, or water which may be added by the contracted septic pumper, would rapidly infiltrate into the exposed soil, only a dry solid cake would remain. Thus, removal could only be accomplished manually. Solids which had accrued in some of the more frequently used facilities were not yet to levels meriting immediate health concern (to the point where the troops may come in direct contact with waste matter). Due to extremely slow anaerobic degradation of the solids, levels will continue to rise within these pits unless periodically removed. These facilities had not been maintained since their installation - leaving elevated levels of solids within several pits. This had created an environment suitable for the propagation of vector organisms capable of transmitting disease, as well as aesthetically displeasing odors emanating from the anaerobic decomposition of the solids. Such factors may well lead to troops utilizing unapproved, improper field sanitation practices during future training exercises. Regardless of what remedial action is selected for future use, solids collection and disposal should be accomplished prior to the FY 88 training season.

c. Retrofit Construction.

(1) The existing open-pit structures may be retrofitted with bottoms to provide a vaulted facility which would effectively preclude the percolation of wastewater down to ground water. Several options are available to accomplish this; however, CERL has recommended and the OCE has

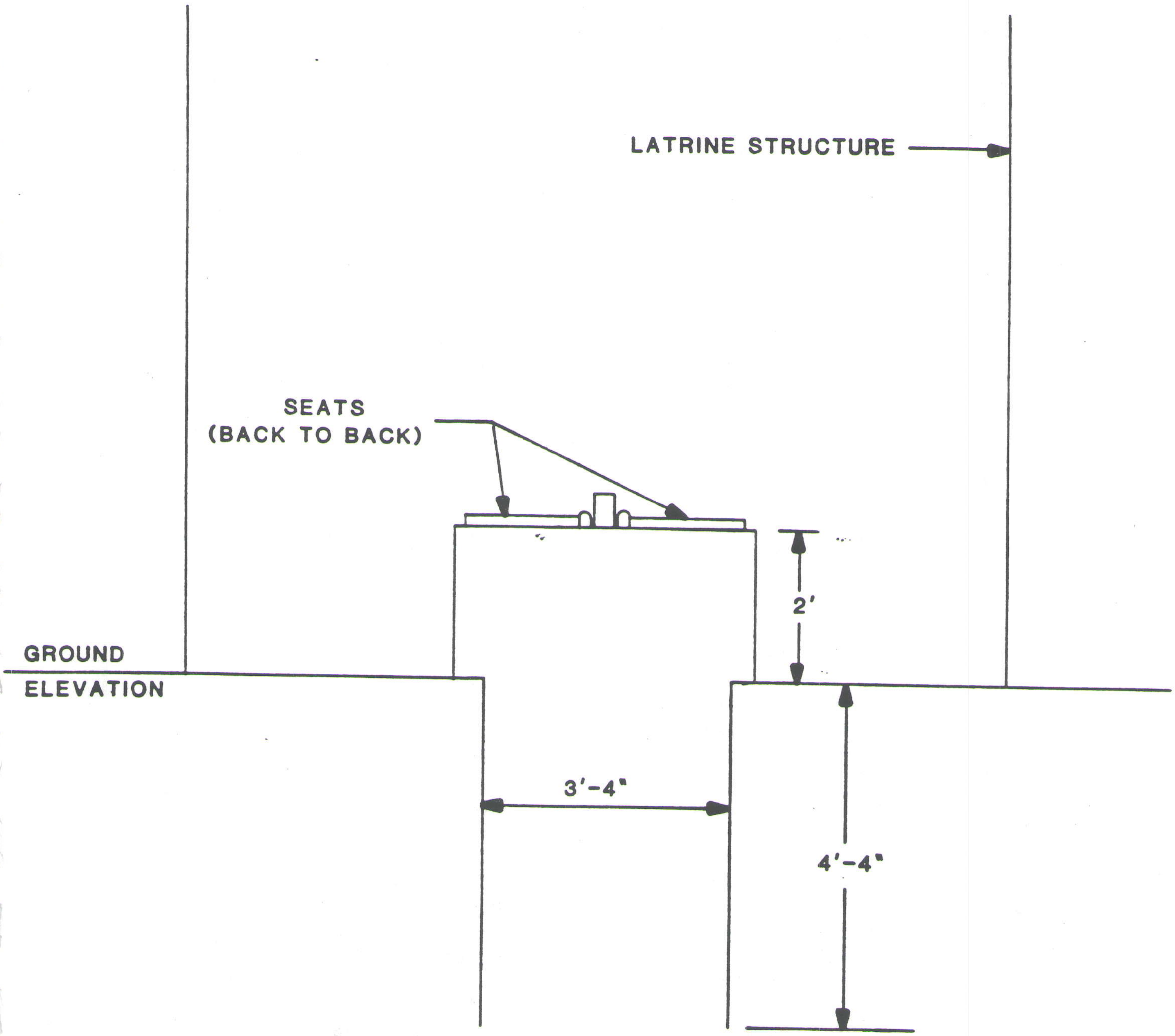

FIGURE 1. SCHEMATIC DIAGRAM OF TYPICAL OPEN-PIT FIELD LATRINE

endorsed (references 8 and 10) the utilization of a synthetic rubber liner which is pliable to the point where it may be inserted intact through the existing cleanout port. The Hypalon liner suggested in reference 8 is a 45-mil, nylon-reinforced material which would be attached to the upper concrete block wall by 1- x 3-inch treated boards. This, or a similar liner must be covered by several inches of poured concrete to preclude puncture by glass, rocks, and septic pumpout hoses.

(2) Waste removal is a major consideration in the design and maintenance of such facilities. When a water-tight vault is present, the wastewater and accumulated solids must be periodically removed and disposed of in an approved manner to minimize the presence of foul odors and vectors for potential disease transmission. Such services may be readily contracted to a qualified septic tank pumping service, who would be responsible for the removal and disposal of solids and wastewater to an approved land or sewage treatment facility. Latrine facilities which receive continuous use throughout the training season may require cleaning twice during the year; however, it is envisioned that a single pumpout/cleaning might be sufficient during that timeframe.

(3) The OCE has endorsed (reference 10) the findings of CERL, which recommends the installation of aerated vault latrines or composting latrine facilities for remote site waste handling. This would eliminate the application of conventional vault latrines wherever possible by adding an onsite aeration or composting capability, respectively. The installation of aerated vault latrines appears to be the more feasible of the two alternatives from the standpoint of both cost and manpower requirements. A motor/blower unit supplying forced air through a perforated pipe located near the bottom of the vault would provide enough air to maintain aerobic conditions within this unit, and preclude the problems associated with an anaerobic environment. Routine maintenance of the motor/blower would be required, as well as contracted cleanout activities, as discussed above. The primary drawbacks to this approach would be the requirement for electrical service hookup and subsequent energy consumption costs. While such an operation may create conditions more amenable for use, the difficulties associated with electrical hookup at these remote locations may favor the utilization of conventional vault latrines. If the decision is made to use the latter, command emphasis would be required for the consistent use of field latrines during annual training exercises.

(4) The installation of retrofitted water-tight vault floors would appear to be the remedial measure of choice at Camp Edwards, should one be deemed necessary. This option would provide complete protection to the underlying aquifer from leaching wastewater and assure the installation, regulatory and community authorities that no contamination will emanate from these sources. Retrofit with Hypalon, or similar liners and concrete would prove relatively inexpensive (up to $1,000 each) (reference 8) and would require minimal repair/maintenance by installation personnel. A

service contract would be necessary, however, to facilitate the extraction and proper disposal of collected wastes annually, at a minimum. The equipment and labor necessary to create aerated vault latrines has been estimated by CERL (reference 8) to cost an additional $2,000 per unit. The primary constraints to the aeration option involve the provision of electrical power, associated energy costs, and blower/motor unit maintenance. There appears to be no need for such an upgrade at Camp Edwards.

d. Monitoring Wells.

(1) Retrofit activities may be avoided if it can be shown that the latrines, as currently constructed, posed no threat to ground-water supplies. This may be proven through the installation of properly located monitoring wells which would intercept and define any contamination emanating from the pit latrines. Also, it was determined that the ground-water downgradient from a cluster of latrines would be examined, if possible, to simulate a worst-case scenario and make it easier to detect any potential adverse impacts.

(2) After siting each existing latrine structure on an installation map, two small clusters of facilities were identified in sector C-16 of the training area (within the northeast corner of the Camp Edwards installation boundary) (Figure 2). Buildings 16 and 17, found in the southwestern corner of the sector, are adjacent to one another in an area prominently utilized as a company headquarters/bivouac area during training exercises. Along the eastern perimeter of the sector (and the installation) are Buildings 21, 22, 23, and 24. This area is often used as a brigade bivouac area or as the site of the combat trains operations. These facilities are grouped closely enough to meet the objectives stated in paragraph 4d(1).

(3) Next, the basic direction of ground-water flow was determined in order to properly site such wells. Information provided by the USGS (reference 16) and the Cape Cod Planning and Economic Development Commission (reference 17) indicates that the central portion of Camp Edwards encompasses the primary recharge zone for the Cape Cod Aquifer. Water is mounded at an elevation of 60+ feet above MSL in this zone, and flows radially outward from that point. In the selected study area the direction of regional ground water flow is approximately NNE - originating around the impact area and ranges on the eastern side before heading toward the town of Sandwich.

(4) Review of the numerous drilling operations which have been accomplished at this installation indicates that the one major water-bearing zone underlies this facility; however, lenses of relatively impermeable soils which may create additional, localized water-bearing zones above the Cape Cod Aquifer have been encountered. Records compiled by the Waste Disposal Engineering Division of this Agency (reference 11)

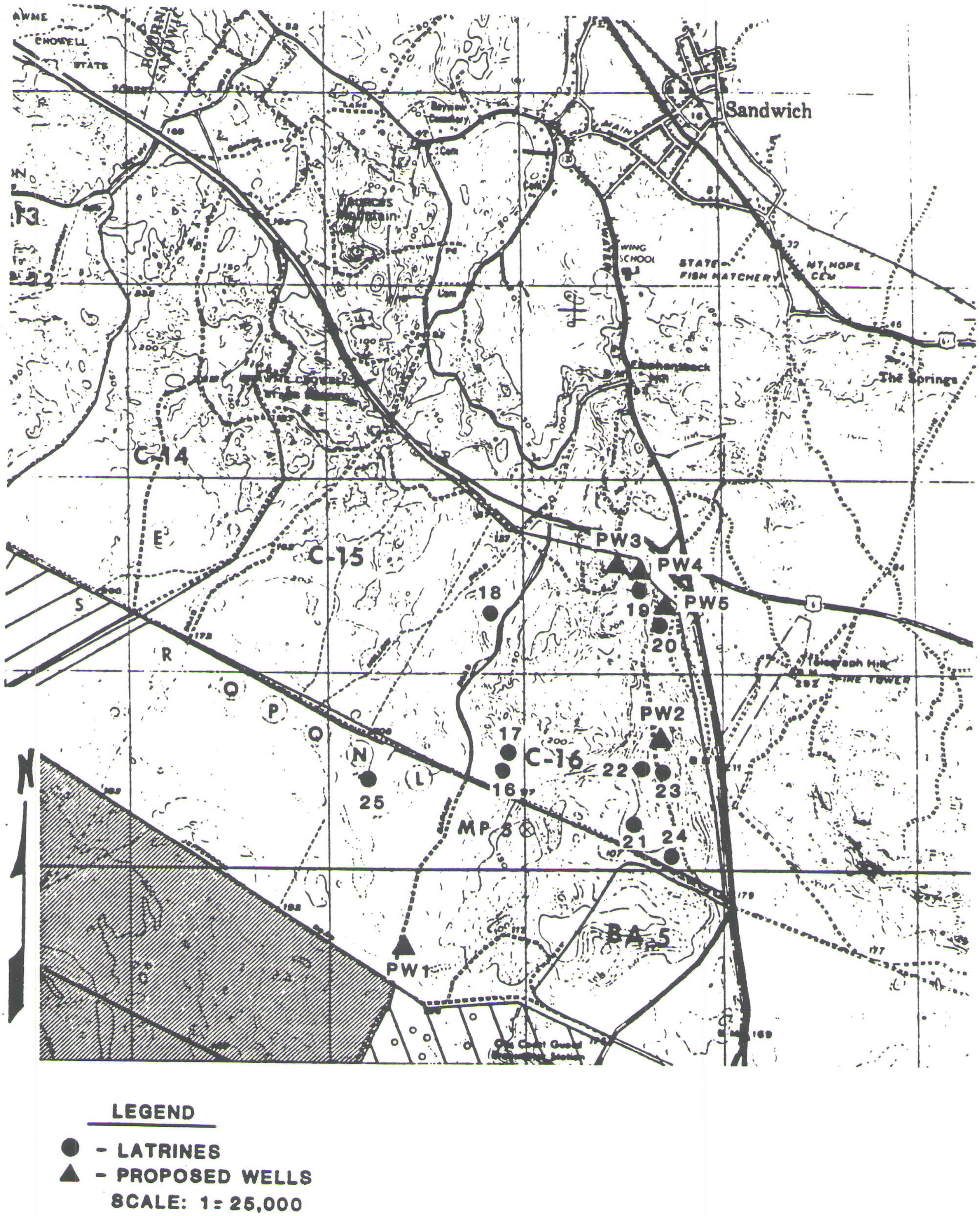

FIGURE 2. LARTINE AND PROPOSED WELL (PW) LOCATIONS

and E.C. Jordan Co. (reference 5, 6 and 8), as a part of the Installation Restoration Program, display ground water at levels ranging from 30-160 feet below the surface, with intermittent levels observed between 30-55 feet. (The exact level varies with the topography.) It is recommended that each proposed well site location possess at least two adjacent wells - one penetrating each of these water-bearing zones (if more than one is present) or at different levels within the protected aquifer. The exact depths at which these wells are to be screened should be determined onsite by qualified personnel, as the holes are drilled.

(5) Five well sites are recommended to identify the impact of these latrines on ground-water quality. One site should be located upgradient of the subject latrines, to define the water quality prior to any influence from these structures. Existing wells - installed by E.C. Jordan Co., Roy F. Weston, Inc., or this Agency - and concomitant data were evaluated to determine if background information was already available; however, none of these sites were in areas adjacent to the subject field latrines. Therefore, it is recommended that the background well(s) be located on the eastern side of Barlow Road, just north of the impact area. Specific grid coordinates and estimated depths to ground water for proposed well locations, as well as the latrines encompassed in this study are presented in Appendix C. An additional well site should be located immediately adjacent to (and downgradient of) the latrine clusters of concern. This would be located just north of Buildings 22 and 23, along the tank trail. This site should provide information pertaining to the immediate/localized impact of the wastewater flows. The final three well sites would be located as far downgradient from the subject facilities as possible on installation property, as indicated on Figure 2. The downgradient wells would provide data regarding the concentration and persistence of any contamination (e.g., nitrates) emanating from the latrines, as well as provide general information regarding the quality of ground water leaving the installation boundary. This latter concern may prove critical, as little site-specific information was available regarding the location and use of water supply wells in this region. All proposed well sites are located along or near existing roads or tank trails, and would be easily accessible to drilling equipment. An analysis of the soil characteristics may be conducted at each site during the drilling operation.

(6) The wells should be monitored for a minimum period of 1 year before assimilation and interpretation of the data. A proposed schedule would involve the collection of samples at least 4 times during the year - twice within 1 week of annual training exercises (utilizing this sector of the training area) and two other events during periods of relative nonuse in the Fall-Winter months (e.g., November and March). This would provide information regarding measurable, immediate impacts of leaching wastewaters, as well as the presence of persistent contamination, if any, from these sources. Sample analysis should be contracted to a reliable, certified laboratory, whose results will be readily accepted by the State DEQE. The analyses recommended include: nitrate and nitrite-nitrogen, total

Kjeldahl nitrogen, ammonia-nitrogen, total phosphates, specific conductivity, chlorides, total dissolved solids, pH, and temperature. (The latter two analyses, pH and temperature, should be conducted onsite at the time of sample collection). Additional parameters may be added if desired or required by DEQE; however, these parameters should be kept to a minimum. (State ground-water quality standards for Massachusetts have not been published in the BNA Environmental Reporter, to date). Substances observed in any of the downgradient wells which are not present in the background wells should indicate an adverse impact imparted by leaching from the open-pit latrines - suggesting remediation by some measure of retrofit. The absence of contaminants, conversely, might indicate the absence of such an impact; thus, requiring no short- or long-term remediation. Extended monitoring - for an additional year, or whatever is required by the State - should be undertaken to confirm such conclusions.

(7) The costs incurred by this alternative action would include the drilling, installation, and development of wells by a contractor, the collection and analysis of samples during the prescribed periods (over a 1-2 year timeframe), and the installation of requisite remedial measures, if deemed necessary. As a result of discussions with DEQE or EPA authorities, it may prove necessary to install monitoring well clusters at specified locations (e.g., downgradient from all potential sources of contamination), in conjunction with the recommended retrofit addressed in paragraph 4c(4), to assure them that no continued leaching of contaminants may migrate to offpost water supply wells.

e. Evaluation of Wastewater Input. The implementation of the aforementioned remedial measures would provide confidence that wastewater emanating from the field pit-latrines at Camp Edwards would not adversely impact the ground-water systems. A further evaluation performed by local and state regulatory authorities may provide a similar conclusion; thus, precluding the need for further onsite construction/monitoring activities. Although, a paucity of information exists which hampers an adequate quantitative evaluation of this wastewater input, there are several factors in evidence which would support the notion that this contribution to ground water would be insignificant. Generally the nutrient uptake capabilities of soil have been well documented (references 12, 19, 20, 22, and 23), which should significantly reduce the amount of contaminants reaching the ground water. The depth of unsaturated soils (e.g., 30-160 feet) overlying the protected sole source aquifer would also play a critical role with respect to nutrient loading which would occur. (For example, land application systems for the treatment of domestic wastewaters generally must possess a minimum of 5 feet between the ground surface and ground-water elevations). Generalized conclusions regarding contaminant inputs are complicated by such factors as the rapid permeabilities observed in this region, as well as a lack of knowledge pertaining to site-specific contaminant dispersion characteristics and the potential impacts upon "downgradient" water supply wells in the area. Due to these confounding factors, it is, therefore, difficult to recommend that no remedial action be undertaken, regardless of the apparent insignificance of contaminant and flow input to ground water.

f. Regulatory Authorities Input. Armed with the information provided and recommended in this report, the installation/MARNG authorities should ask DEQE, and possibly EPA, as to what action they will require or recommend. Because of the political and legal controversy surrounding activities at Camp Edwards in recent years, along with the environmental sensitivity exhibited by neighboring communities, the State may predetermine that each of these structures should be retrofitted with a water-tight bottom to preclude the percolation of wastewaters. As previously mentioned, this was stated to be the situation in an Environmental Assessment document published in 1985. Conversely, DEQE may concur with the discussion presented in paragraph 4e, consider the problem insignificant, and recommend that no action be taken. Ultimately, the action taken by installation personnel will be dependent upon the decisions and guidance provided by these regulatory bodies.

5. CONCLUSIONS. Nitrate contamination of the Cape Cod Aquifer has historically posed a major concern for water resource planners in this region. Although it is apparent that the contaminant input into ground water from the subject wastewaters would be insignificant, the lack of detailed, site-specific information makes it difficult to substantiate or recommend this fact. Alternatively, the installation of water-tight bottoms to transform existing structures into vault latrines may be accomplished to preclude all possibility of ground-water contamination from these sources. This information needs to be presented to DEQE and EPA to ascertain their guidance/requirements. The accumulation of solids in pit latrines needs to be removed and disposed of properly, on a recurring basis, to maintain amenable aesthetic conditions which would facilitate continued troop usage during training exercises.

6. RECOMMENDATIONS. To ensure good environmental engineering practice, the following recommendations are made:

a. Clean accumulated solids out of the existing field latrine pits prior to the next training season and at least annually thereafter (this report, paragraph 4b).

b. Appraise the State DEQE and EPA of the existing situation and findings of this report, and solicit appropriate guidance (this report, paragraph 4f).

c. Install impermeable liners and concrete to retrofit latrine structures as vaulted facilities [this report 4c(4)].

7. TECHNICAL ASSISTANCE. Requests for services should be directed through appropriate command channels of the requesting activity to the Commander, U.S. Army Environmental Hygiene Agency, ATTN: HSHB-ME, Aberdeen Proving Ground, MD 21010-5422, with an information copy furnished the Commander, U.S. Army Health Services Command, ATTN: HSCL-P, Fort Sam Houston, TX 78234-6000.

8. REFERENCES. A listing of references used is presented in Appendix D.

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APPENDIX A
ABBREVIATIONS

CERL	U.S. Army Construction Engineering Research Laboratory
DAC	Department of the Army Civilian
DEQE	Massachusetts Department of Environmental Quality Engineering
EPA	U.S. Environmental Protection Agency
FR	Federal Register
MARNG	Massachusetts Army National Guard
mg/L	miligrams per liter
MSL	Mean Sea Level
NNE	North-Northeast
OCE	Office of the Chief of Engineers
pH	The negative logarithm of the effective hydrogen ion concentration used in expressing both activity or alkalinity
PW	Proposed well
USAEHA	U.S. Army Environmental Hygiene Agency
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

APPENDIX B
PERSONNEL CONTACTED

1. LTC Joseph Roy, MARNG, Facility Manager
2. LTC Anthony Cimino, MARNG, Administrative Assistant
3. CPT Edward Pesce, MARNG, Facilities Engineer
4. 2LT Robert Cannon, MARNG
5. Ms. Mary Lou Botellho, Real Property Clerk
6. Ms. Elenora Babij, HQ STARC Environmental Protection Specialist
7. Ms. Jamie Rappaport, Environmental Specialist, U.S. Army National Guard Bureau

APPENDIX C
FIELD LATRINE AND PROPOSED WELL LOCATIONS

Building No.	Grid Coordinates*	Ground-Water Elevation†	Estimated Depth to Ground Water‡
16	749205	60+ feet above MSL	120+
17	749206	60+ feet above MSL	110+
18	748213	47 feet above MSL	165+
19	756214	42 feet above MSL	110
20	757213	45 feet above MSL	105
21	755203	60+ feet above MSL	35-40
22	756205	60+ feet above MSL	30+
23	757205	60+ feet above MSL	30+
24	757201	60+ feet above MSL	60+
25	742205	60+ feet above MSL	130+
PW1	743196	60+ feet above MSL	120+
PW2	756206	60+ feet above MSL	30+
PW3	755216	40 feet above MSL	90
PW4	756215	41 feet above MSL	100
PW5	757213	43 feet above MSL	95

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* Grid coordinates were extracted from special installation map, reference 16.

† Approximate ground-water elevations obtained from special map of water table contours, reference 15.

‡ Estimated values obtained from special map of water table contours (reference 17) and special topographic map of Camp Edwards (reference 18). Units - feet from surface.

APPENDIX D
REFERENCES

1. FM 10-52, 27 February 1985, Field Water Supply.

2. FM 21-10, 22 December 1983, Field Hygiene and Sanitation.

3. Title 40, Code of Federal Regulations (CFR), 1986 rev, Part 141, National Primary Drinking Water Regulations

4. Proposed Rule, Water Programs, Sole or Principal Source Aquifer Areas, 42 FR 51620, 29 September 1977.

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7. Report, E.C. Jordan Co., 15 April 1987, U.S. Air Force Installation Restoration Program, Sewage Treatment Plant and Off-Reservation Ground Water Studies at Massachusetts Military Reservation, Massachusetts, Final Report: Task 1.

8. Report, CERL, CERL-IMT, December 1986, Technology for Waste Treatment at Remote Army Sites (Technical Report N-86/20).

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10. Technical Note No. 86-4, OCE, DAEN-ZCF-U, 30 September 1986, subject: Composting Toilets and Vault Aeration.

11. Letter, USAEHA, HSHB-EW-R, 14 March 1986, subject: Water Quality Engineering Consultation No. 31-24-0676-86, Impact of Field Training Activities on a Sole-Source Aquifer, Camp Edwards, Bourne, Massachusetts, 3-7 June 1985.

12. Letter, USAEHA, HSHB-ES-G, 30 April 1986, subject: Geohydrologic Study No. 38-26-0500-86, Camp Edwards, Massachusetts, 8-20 July and 9-17 September 1985.

13. Report, MARNG, June 1985, subject: Camp Edwards Military Reservation - Environmental Assessment.

14. Report, USDA, Soil Conservation Service, December 1980, Soils and Their Interpretations for Various Land Uses - Camp Edwards.

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16. Report, USGS, August 1980, Cape Cod Aquifer, Cape Cod, Massachusetts, Water Resources Investigations 80-571.

17. Special Map, Cape Cod Planning and Economic Development Commission, 1982, Bourne-Sandwich Water Table Contours and Public Water Supply Well Zones of Contribution.

18. Special Map, Defense Mapping Agency, 1975, Series V8145, Edition 2-DMA, Camp Edwards.

19. Koerner, Ernest L. and D. Alan Haws, EPA-Office of Research and Development, March 1979, Long-Term Effects of Land Application of Domestic Wastewater: Vineland, New Jersey, Rapid Infiltration Site, EPA-600/2-79-072.

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